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ABSTRACT

As part of the national assessment program in Sweden there have been two attempts to gain insight into students' "know-how" with knowledge. The first was a study conducted in 1992 that showed that students had not reached the goals established by the Swedish national curriculum for ninth graders with regard to an exploratory and critical way of working. This study builds on the earlier study to evaluate the extent to which the upper secondary school fulfills its goals concerning teaching and training students to work in a more scientific way. Students from 50 classes worked in groups of 4 or 5 to explore issues related to genetic testing information and gene technology. Data came from work protocols of 167 groups, 707 student questionnaires, 42 teacher questionnaires, 179 articles, and 21 teacher observation protocols. Planning, critical thinking, decision making, and information seeking and shifting skills were investigated, as were cooperation and taking responsibility for group work. Students were relatively good at cooperating and at taking responsibility for their work. They were not very good at sifting information and there was little evidence of critical thinking, although there were many examples of student reflection on their own work. Students still fall short of the curriculum's goals for dealing with knowledge. Questions about the fairness and quality of the assessment of know-how with knowledge are explored. (Contains 11 references.) (SLD)

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ED 410 240

EVALUATING STUDENTS' KNOW-HOW WITH KNOWLEDGE

Problem-solving in Groups

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Background

In 1993 the National Agency for Education published a report (Skolverket, 1993a) in which a picture of the Swedish school was given. A common pattern in the compulsory school is that the teacher speaks and the children listen and answer questions. The pupils exert very little influence on the planning of their education. They also have difficulties analysing and solving problems, seeing relations, discussing and framing arguments.

Despite the dominance of the pattern of teachers speaking and children listening and responding, there are differences between teachers' practices and what they really want to do. In general teachers wish to see the pupils actively involved in their learning, making excursions, holding discussions and they would like to give them practical problems to solve. They want to let the pupils choose their problems and to plan their work more by themselves. But they see the timetables and organisation of schools presenting obstacles to such approaches.
The way of working at school may relate to the lack of involvement of the pupils. This will in turn have consequences for educational attainment. While the school work is organized in this way, the pupils in compulsory

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schools are given few possibilities to explore and develop their abilities to work independently.

These conclusions are drawn mainly from the national assessments of 1992. In the national assessment programme in Sweden there have been two attempts to reach special insights into pupils´ know-how with knowledge, attempts to attain more complex information and to get at both products and processes.

The first study was conducted in 1992 (Skolverket, 1993b) in 239 groups of (4-5) pupils leaving the Swedish 9-year Compulsory School. The problem area was outlined (acid rain) but the pupils had to select a question and break it down and define it more exactly. The pupils themselves had to choose the investigation and design and implement it in a way they decided themselves. The implementation was entirely open and so was the answer.

The results showed that 60% of the groups limited themselves and kept to the subject. Only 40% followed their plans and treated the questions they intended to. The pupils showed little independence in relation to their written information sources and copied long passages from books and brochures without sifting the information. The pupils however showed greater independence in relation to persons as sources of information. Of the investigations performed, only one third was based on a question or tested a hypothesis. For about one quarter of the investigations a description of the method was given, i.e. the group described the steps they took. Only 10% of the groups have attempted to explain the results of their investigations. The pupils´ ability to report on their work was satisfactory as far as the form of the report is concerned. As regards the content the situation was different. The pupils´ ability to work in groups, to organize their work, so that the group functioned socially, and so that a product was finished, was satisfactory.

The results of the assessment show that the pupils have not reached the goals set up by the curriculum (Lgr 80) for the 9-year compulsory school regarding an exploratory and critical way of working.

The most likely hypothesis for this underperformance is that teachers do not expect enough from the pupils as far as processing skills are concerned. The pupils schould take a greater part in actively planning their own work. They schould work with more unstructured tasks which would require them to define and formulate their problems themselves. The pupils schould select their sources of information more freely and also be trained to examine them critically. They schould work with less structured, and thus more realistic contexts. The pupils schould have

greater freedom to select their methods of investigation, while learning to evaluate appropriate methods.
The second study was carried out in 1995 in 188 groups, Grade 12 (age 19) and the students had to take up a position in a controversial gene technology question (Skolverket, 1996). This paper will report the results from this second study.

The new curriculum for the Swedish upper secondary and voluntary school (Lpf-94), proposes that school work which develops independence, problem solving skills, communication skills and abilities to cooperate in groups is important in schools. Furthermore students should develop more and more scientific ways of thinking and working. They should increase their capacity to develop an argued position and base it on empirical evidence, critical analyses, rational and ethical considerations. They should use their knowledge as a tool to formulate and test hypotheses and solve problems. One of the main tasks for education is to let the students practise critical thinking, checking facts and conditions, and to realize the consequences of different alternative solutions.

The aims

The intention is to take advantage of the experiences from the construction, trials and realization of earlier mentioned problem-solving test of 1992. The aim is to evaluate to what extent the upper secondary school fulfils its goals concerning teaching and training the students to work in a more scientific way. This is a difficult assignment to evaluate in a short time. Given a special task, however, the students can show the extent to which they are able to perform such a task and this will be a sign of how well prepared they are to work in a more scientific way.

At the same time this evaluation instrument aims at promoting development at the local school level.

Method

The sample, instrument and realization

The method was to put groups of students in a real situation, where they performed a more extensive (8 hours) decision-making task, dealing with

an important and complex question. The task was a multifaceted one, very open and allowed for choices of different steps and strategies so the students were given control over their learning (Sharan & Sharan, 1989). Attention was paid to the importance of formulating the task (Herz-Lazarowitz, 1989). The groups as well as the teachers kept diaries about how the work advanced and afterwards answered questionnaires. In this way they contributed to the insider perspective (Radnor & Shaw, 1995) while they were involved in the groups´ process-to-product continuum. The external assessors hold the outsider perspective and were involved with a product-product continuum, and comparisons between groups. Both perspectives are complementary to each other and support the evaluation.

50 classes were chosen from the final classes in the upper secondary school (year 12), involving all programs and all streams in order to get a representative sample of students. Five controversial issues in gene technology were formulated. The students worked in groups of 4-5, chose one of the issues (questions), took up a position, based it on empirical evidence and found arguments for this position. They also had to formulate and present their view in a short article, a contribution to a debate in a newspaper.

There was an introduction to each issue but only the questions are presented here:

1. Should it be permitted or forbidden to give out genetic information about a person?
2 Should it be permitted to select special embryos to let them live while others are destroyed?
3. Should it be permitted to put out gene technically manipulated organisms in the environment?
4. Should gene technology be allowed in order to increase the equality between people?
5. Is it a good thing to decrease the biological variety in order to get a few new high producing varieties?

The students could choose to look at the question in a scientific, technical, ethical, social, religious, economic, psychological or any other way. There were few constraints and hopefully each group would find something of interest to them. Eight lessons were arranged to suit the school. The task demanded some home work too. The test was tried out in the autumn of 1994 and given in March 1995.

The whole instrument was composed of several parts. The input was an introductory video tape, the task including five questions (issues) and a teacher introductory sheet. The output was 167 groups´ work protocols,

707 student questionnaires, 42 teacher questionnaires, 179 articles and 21 teachers´ observation protocols.

Analyses and evaluation

The empirical data collected in the study was varied and rich and provided information from which the qualities found in the work of the students were identified. The analysis was carried out by finding evidences in the students´ work for the following six social and cognitive skills: responsibility, cooperation, planning, information seeking, critical thinking and decision-making, all put forward by the Swedish curriculum.

All information given from the five different types of sources (teacher and student questionnaires, group articles and group protocols and teacher protocols) was used and put together for every group in the effort to reconstruct the work. Every of the six skills was broken down into several operational units or simple observations. Together 181 pieces if information were searched from every groups´ work. The signs in form of written expressions were all collected and used in the analyses.

The results are founded on interpretations and judgements of different kinds of written information produced by students and teachers, by those who were there. The evaluation was realized through socially constructed agreements where critera for the different skills were discussed.

Results

In evaluating the problem solving skills six different skills are included, all interpretations, sifted out from the Swedish curriculum. Four of them are more cognitive; planning skills, critical thinking skills, decision making based on arguments and abilities to seek and sift information. Two of the skills are more social; abilities to cooperate and take the responsibilities for the work in the group. The groups are better at social than cognitive skills.

The results show that the students were relatively good in cooperating. In three of four groups (totally 188 groups) the cooperation was satisfactory. The teachers decided upon how to form the groups and they chose to design them as heterogenous as possible containing as many different abilities as possible. This seemed to be a good choice. Cooperation was by the students considered to be good if the

communication in discussions, argumentation and listening was good. Important features in a well cooperating group was also that the members helped each other, listened to each other and that everone was allowed to decide in the group and that everyone put in as much effort as the others.

The students were also good in taking responsibility for their work. In two out of three groups (of 188 groups) all members have shown responsibility. Responsibility is taken at two qualitatively different levels; usually the student takes personal responsibility for his or her own work in the group, but now and then you could find a student taking responsibility also for the work of the whole group. The personal responsibility is emphazised in the Swedish curriculum, and so is the responsibility and solidarity for people outside the closest group. In spite of the fact that nothing is mentioned about taking responsibility for the members in the closer group, there are single students taking responsibility in this wider sense.

Plans are usually made starting out from a stereotyped model of how group work use to be performed. But there are also examples of plans made with the origin in some questions. Only a small part of the groups (5%) made written plans. Most of the groups orally planned their work either in the beginning or in an impressionistic way from time to time. Many students are inexperienced at planning larger tasks. Evidently the teachers usually do the planning. Afterwards many groups commented upon their planning and thought they would have had advantages if they had planned more thoroughly.

The information search was rich in the sense that they used different kinds of sources; not only books and newspapers and other written materials but also consulted researchers, politicians and organisations. The students used a rich variation of media, that is libraries, searches in databases, internet, telephone, telefax and investigations. They did not copy the texts in the large extent that the younger students did in a similar study (Kärrqvist & Öquist, 1994). The students, however, did not sift the information in a conscious way. Only one out of five groups shows any signs to have some question along when looking for information. Neither did they search very systematically or use long search-tracks. Their questions were often wide, broad and unspecified and not broken up into simple questions to test.

There was very little evidence of critical thinking but there were some examples of students comparing different sources as a control or reflecting upon the reliability of the sources. The students however reflected frequently upon their own work in the questionnaires.

Two of three groups take up a definite position, in spite of the difficulties in this type of questions - there are no right answers. The students mainly chose emotional arguments rather than arguments founded on facts taking up their positions. Several ethical arguments were also given. The arguments are more or less founded in their own search and investigations. Two of five groups have put forward positive and negative arguments in a way that they can be judged to problematize their question. Together the students have used a variety of arguments and enlightened the given questions from many different aspects.

Conclusions and discussion

The aim of this study was to evaluate to what extent the upper secondary school fulfils its goals concerning teaching and training the students to work in a more scientific way.

Assessments in schools often deal with knowledge and not with know-how with knowledge as a focus. The curriculum however states goals at the higher order thinking level, which contains complex skills, scientific way of working, position-making, argumentation, critical thinking and so on. In connection with testing this know-how through more open questions, practical tasks and real problem situations, the quality of this particularly complex, performance-based assessment can be discussed in relation to the validation criteria, proposed by Linn et al (1991). A question of validity will be raised in connection with this performance assessment.

Did the test really measure what it wanted to measure? Did the task encourage the students to work in a scientific way, that is to use all their problem solving skills including higher order thinking skills in the given task? Which cognitive demands did the task put and what kind of response did it release?

Regarding the construction of the task a high consciousness was present. The open task was supposed to offer opportunities for the students to really take control over their own work and be forced to use their problem solving skills. And the demand of position-making would stimulate cooperation in a deeper sense (Herz-Lazarowitz, 1989).

But to what extent did the students really take the opportunity to show their skills in the test? This question is always present. As soon as a student is put into a situation defined by the researcher and has to respond, the student has to choose the response level. The student uses all possible soft information to be able to judge at what level the answer is to be given. This might be a level that on one hand will be considered too

low by the researcher, on the other enough. In this case extensive information was given to the schools and the teachers in advance, and with the conscious wish to set the scene and show the large possibilities the students were given in the coming task. This was done in order to create good conditions and opportunities for the students to do their best.

Does the evaluation give a fair result? How much did the choice of gene technology as the topic mean to the results of the test? Are there something you can call general problem solving abilities. Or can these abilities only be measured in relation to a special issue?

There are different opinions (Howe et al, 1990) about if there are something called general skills, which can be generalized across different subject matter or if you can talk about skills only in relation to a specific subject matter. For instance, in order to be able to use critical thinking in dealing with a subject matter, neccessary prerequisites would be to be familiar with the matter. An explanation to why so few students show evidence of critical thinking could accordingly be that they are not very familiar with gene technology. On the other hand there must be a transfer effect of cognitive skills, otherwise it would be impossible to talk about preparing students to solve new problems in the future (Perkins, 1985).

In this test the students had the possibility to choose level, aspects and direction of their work. It is tempting to say that this gave them a chance to choose a perspective that they felt familiar with and could perform good at. Another reason why the results are fair, are that 80% of the teachers have judged that 80% of the students have worked at or above their ability with the task.

Implications

It will be a large task to improve the students awareness in the mentioned respects and it requires joint work by all the teachers at school. Together they have to organize the teaching in a direction that gives the students possibilities to practise a scientific approach to their tasks.

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